ORGANIC GARDENING

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Editor of ORGANIC GARDENING

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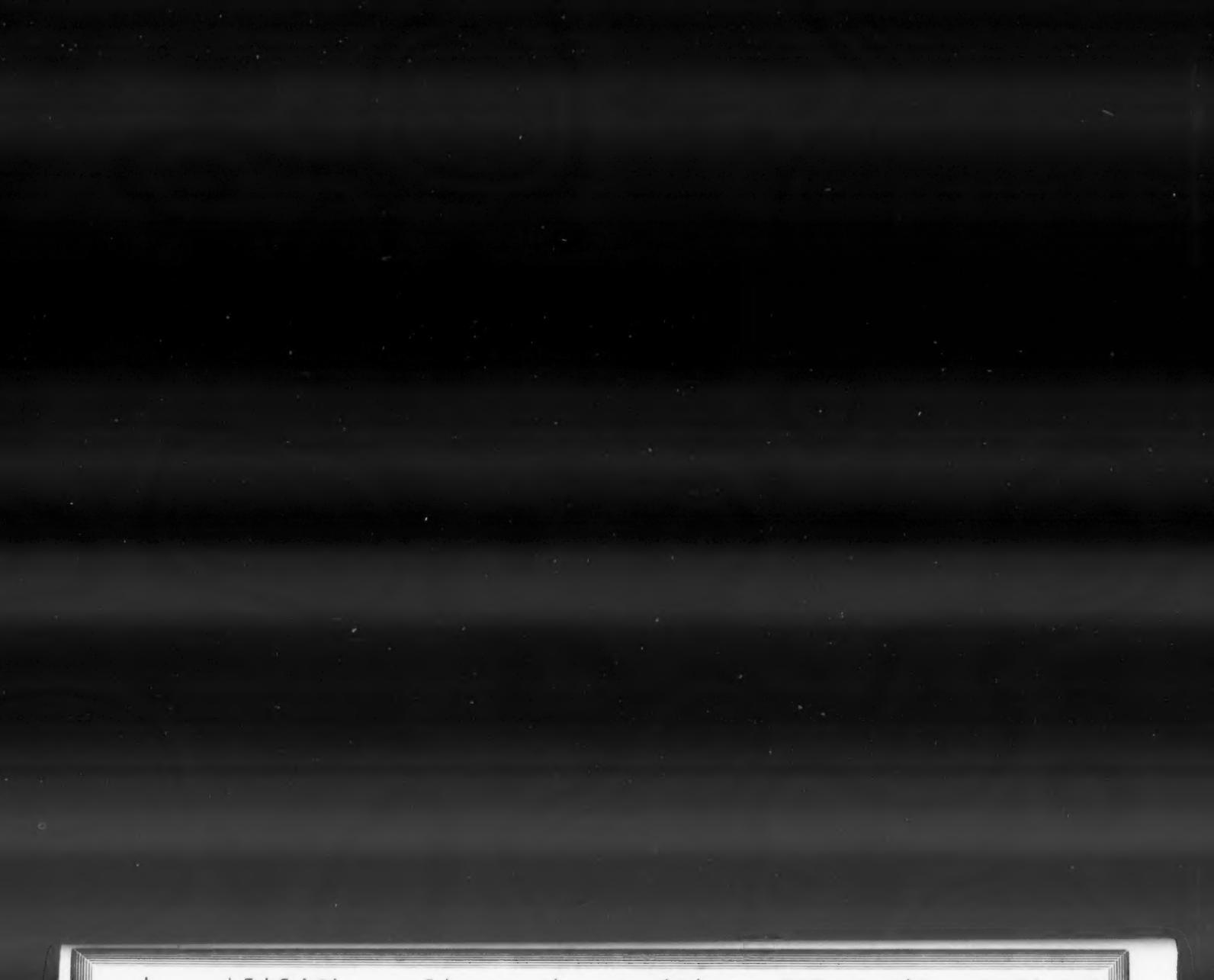

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J. I. Rodale, Editor Sir Albert Howard, C.I.E., M.A., Associate Editor

With The Editor

The Biologic Life of the Soil

LIFE cannot go on without the ubiquitous microbe which seems to be everywhere. Without them there would be no soil. Originally the earth consisted of rocks which were slowly weathered and disintegrated by bacteria and fungi, etc. Thus the microbes made the soil and now regulate its operation. Without them there would be no products such as vinegar which is produced by a fermentation process in which they take a prominent role. There would be no cottage cheese, sauerkraut, dill pickles, wines, bread and many other products which depend on microscopic life for their process of manufacture. There would be no growing crops. Bacteria are regularly employed in many industries such as leather tanneries and lubricating oil refineries. You could not cure tobacco without these organisms. They are an essential part of our everyday life. Yet before 1850 nobody knew anything about them.

Louis Pasteur was the father of bacteriology. His first practical application of this science was to show French vintners how to prevent spoilage of wine. When a certain batch spoiled they thought it was bewitched. Pasteur worked out a method of low heat pasteurization which kept the wine-making process under the absolute control of the operator, albeit he had to add a microscope to the winemaker's other equipment. He saved the silk industry of France which was rapidly being destroyed by a disease of silkworms. He cured *anthrax* in sheep and everyone is familiar with his work in connection with *rabies*.

For the next 75 years microbes were practically monopolized by the medical profession, and also used in industry but shamelessly neglected by agriculture. It is only in the last few decades that scientists have begun to study the ways of these microscopic beings and their effect on growing crops. The soil is not, as many suppose, a dead, inert substance. It is very much alive and dynamic. It teems with bacteria, actinomyces, fungi, molds, yeasts, protozoa, nematodes, algae and other microscopic organisms. All of these except the protozoa and nematodes, are microscopic plants. The two mentioned represent tiny animal life. As a group they are referred to as the biologic life of the soil.

The microbial population of the soil is concentrated mainly in the upper 5 or 6 inches where will be found also the bulk of the organic matter. That is why finished compost should not be plowed under too deep. It should

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either be disced in the surface or plowed under shallowly. When you get down to 3 feet you may find only 30 to 40 thousand bacteria per gram of soil, whereas in the upper levels it may reach billions. In a very fertile soil the amount of bacteria in an acre may weigh as high as 600 pounds. Their decaying bodies turn to humus and enrich the soil. Most of them are beneficent, helpful organisms, others are not. They live together, it seems, in a delicate, balanced relationship closely controlled by nature. If soil conditions get out of hand because of the intrusion of foreign elements (strong chemicals, for example,) the relationship becomes strained, and it becomes more difficult to grow plants in it the way nature intended. In this subterranean microscopic world there are "police" elements which control the "bandit" microbes. This will be developed further in a later issue when the various, spectacular, new curative substances such as *penicillin, gramicidin, tyrothicin, vivicelin* and *chlorelin* are discussed. All of these come from the soil microbial life. The Society of American Bacteriologists has classified about 1,000 species of bacteria; Of this number only about 100 are pathogenic, that is, capable of bringing about disease in plant, animal or man.

The microbes are the real manufacturers of plant food in the soil and not only do they make it but in some cases (the mychorriza fungus) actually feed it to the plant. They perform the very valuable function of breaking down or decomposing organic matter. They condition the soil and its structure. Research workers of the U. S. Department of Agriculture have discovered two ways in which they do this. Decay bacteria secrete a mucus that glues the fine particles of soil into masses that resist washing effect of rains, that otherwise would cause soil erosion. Fungi that feed on plants throw out thread-like filaments or *mycelium* which bind together soil particles into larger masses. Nitrogen-fixing bacteria work in the roots of leguminous plants to extract nitrogen from the air. They no doubt perform other functions as yet unknown. They work in partnerships. Algae may help bacteria. The latter may furnish food for protozoa. But it seems to be a well-regulated little society. All it needs is a diet of the kind of food it likes and a few other necessary conditions.

What are these conditions? First there should be sufficient aeration. Most soil bacteria need a certain amount of oxygen. Following a system of agriculture as suggested by Sir Albert Howard with the stress on composts, the soil structure becomes comparatively loose and porous, encouraging maximum microbial multiplication. Conversely, systems that depend overly on chemicals, find eventually a hardpacked soil unfriendly to soil organisms.

Moisture is very important but not too much of it. The physical structure of a soil gained by years of organic farming becomes perfect for retention of the proper amount of moisture. With a hard-packed soil you have either a desert-dry condition or one too saturated with water. This encourages the anaerobic bacteria which can live without oxygen, but which gives rise to a condition of putrefaction rather than fermentation in the breaking down of organic material.

The earth's microscopic citizens like it warm, that is, between 70 degrees to 100 degrees Fahrenheit. Here again a soil constantly enriched with organic matter becomes warmer earlier in the spring than one which has been abused with strong chemicals. It is a generally accepted fact that the constant application of humus to the soil will gradually darken it and eventually turn it almost black. Experiments at Government stations have shown invariably that the darker the soil the more warmth it will absorb. As between a real dark and a yellowish soil there may be a difference of as much as 8 to 10 degrees. This is extremely important because if the soil warms up earlier in the spring the farmer can get on to his land earlier. For the same reason a white horse can stand the heat better than a dark one because it doesn't absorb as much heat. A white suit is supposed to be cooler. A barn painted white absorbs much less heat than one painted red and grains therefore will store much better in such a place. Even in the case of stones which gradually disintegrate and form soil, darker rock, because of the fact that they absorb more heat, will weather quicker and thus form soil that much more quickly. This may be a factor in the farming of the future, when pulverized rock may take the place of the stronger, caustic chemical fertilizers. Preference might be given to the pulverization and use of darker rocks because such a rock flour will probably break down more quickly in the soil than lighter rock material.

Another factor that helps bacteria is agitation or movement of the soil, because it aerates it more and distributes the moisture more evenly. This was graphically demonstrated by Chester, described in the book "Soil and the Microbe" by Waksman and Starkey (John Wiley). In this experiment the

soil was constantly stirred. The following table shows the tremendous increase in bacteria:

Period of Time	*Numbers of Bacteria Per Gram*
At start	2,040,000
After 7 days	5,495,000
After 9 days	6,171,000
After 14 days	11,326,000
After 24 days	12,600,000

This is one argument against Edward H. Faulkner's "no-plowing" theory as described in his book "Plowman's Folly" (University of Oklahoma Press). His idea is to do away with plowing and to prepare the seed bed merely by discing. Such a practice will be harmful to the biologic life of the soil. Plowing, lifts up the soil and permits the air to get under it. It thoroughly aerates the top 6 or 7 inches or more depending how deep one plows.

Another condition helpful to bacteria is an alkaline soil. They do not thrive when conditions are acid. Fungi can tolerate an acid or alkaline state. In the forest where the soil is acid you will not find too many bacteria. There the work is performed mainly by fungi. Waksman and Starkey in "Soil and the Microbe" just referred to, remark, "Certain fertilizer practices, as continued application of ammonium sulfate without calcium carbonate, increase the acidity of the soil to such a degree as to greatly lower the numbers of bacteria." And again later they say, "From observations of the actinomyces in differently treated plots of soil which were originally the same, it is apparent that, when the soil had become acid following repeated additions of ammonium sulfate, the numbers of actinomyces diminished even to such a low level as 370,000 per gram."

We can say, without fear of contradiction, that the more microbial life in the soil the better for growing crops. Many soil text-books contain the statement that the more fertile a soil is, the more bacteria and other soil micro-organisms will be found. In the same way it can safely be stated that the more manure applied to the soil the more soil organisms will result. F. D. Chester in Delaware Agricultural Exp. Stat. Bulletin 40 said that "the greater the organic matter or humus in the soil the greater, *pari passu,* is the number of bacteria." *Pari passu* means "with equal pace."

Professor Selman A. Waksman in "Principles of Soil Microbiology" (Williams and Wilkins) says, "By comparing the influence of manure with inorganic fertilizers, Temple found that the addition of sodium nitrate to soil increased the number of bacteria, as determined by the plate method, from 6,500,000 to 8,480,000; the addition of a complete mineral fertilizer increased these numbers to 11,540,000, while stable manure brought about an increase to 23,310,000, on the average of several determinations." He says also, "A direct relationship between the organic matter added to the soil and the bacterial count was also observed by others."

Sir E. John Russell in "Soil Conditions and Plant Growth" (Longmans, Green) describes a bacterial count at the Rothamsted Agricultural Station in England. In a field treated with farmyard manure were counted 28,860,000 bacteria per gram of soil. Where complete minerals plus ammonium sulphate were used, only 15,100,000 bacteria were present. Lyon and Buckman in "The Nature and Properties of Soils" (Macmillan) say "All of the ordinary types of Algae are greatly stimulated by the application of farm manure. . . . . Algae no doubt, contribute to the organic content of the soil." Practically all investigators are in agreement on the fact that the application of organic manures stimulate and increase the biologic life of the soil to a much greater extent than chemical or mineral fertilizers. They are also agreed that by increasing the soil's microbial population we improve it's fertility.

Let us examine some ordinary agricultural practices and their effect on the soil's minute organisms. We find that there are certain species of bandits in the soil that war on plants. We attack them, but in doing so we cannot wage a selective warfare. For every pathogenic organism we destroy, we kill off 10 beneficent microbes. Instead of stimulating the natural activities of this biologic soil society by feeding it with sufficient natural organic fertilizers we douse it with poisonous sprays and caustic chemicals. Factory-made chemicals inhibit the beneficial activities of one of the soil's most important organisms, the Mychorriza fungus. There is no dispute about the fact that the stronger chemicals reduce the extent of the biologic population in the soil. This fact is taken advantage of in medicine when we use antiseptics. The antiseptics are strong chemicals which kill off bacteria, etc. Our strong chemical fertilizers, to a certain extent, are antiseptic to the soil's microbial elements. In the preservation of certain foods chemicals are used such as benzoate of soda which act by detroying the bacteria which otherwise would act to spoil the food. If these chemicals destroy bacteria what do they do to us when we consume them?

Lady Eve Balfour in her book "The Living Soil" (Faber and

Faber—London) describes the action of sulphur-reducing bacteria. When chemical sulphates are applied to the soil these bacteria act upon them and produce volatile sulphur compounds which retard the activities of certain fungi which break down organic matter. The use of a strong fertilizer like ammonium sulphate, therefore, has an inhibitory effect on one of the natural processes in the soil.

Sterilizing the soil in boxes for producing young seedlings as transplants, such as tomato and pepper plants, is a questionable practice. It may kill off the organism responsible for "damping off" of the young plant, but it also kills out many other necessary members of the microscopic life of the soil.

Leguminous seeds such as that of alfalfa, soybeans, sweet clover, etc. are usually inoculated with cultures of bacteria so as to increase the rate of fixation of nitrogen. Such cultures are sold by various firms. The U. S. Department of Agriculture has sold such bacterial cultures to farmers at cost. But they do not always work. Dr. F. B. Smith, soil microbiologist of the Florida Agric. Exp. Station in the July 31, 1942 issue of *Science* said, "The inoculation of legumes has not been uniformly successful, even if it is one of the oldest applications of the science."

In a recent issue of *Horticulture* appeared the following:

"After conducting inoculation tests on 50 pea fields in New York, A. W. Hofer reported that in 44 per cent of the trials, approximately the same yields were produced on inoculated and uninoculated plants. On 40 per cent of the fields the yields were increased from 10 to 55 per cent by inoculation. On the remaining 16 per cent yields were reduced by inoculation. The occurrence of reduced yields after repeated cropping to beans or peas where the soil was neutral or alkaline and where manure was lacking suggests that such conditions may favor the development of some agent such as a bacteriophage which is detrimental to the nodule bacteria." Some of the increases might have been due to certain normal causes.

The old-fashioned farmer would take topsoil from an old field where that type of crop had been growing and sprinkle it over the new soil. He would take about 300 pounds of the old soil that was rich in the nitrogen-fixing bacteria, and distribute it evenly over an acre of the new ground and thus inoculate it. Another method he would sometimes use would be to soak the seed in water obtained by mixing some of the old soil with water. These methods have the blessing of the Agricultural Experiment Stations. In sprinkling soil it should be done on a cloudy day or in the evening and should be disced or harrowed in immediately.

An unusually interesting question is the possible relationship that exists between the earthworm and the microscopic residents of its little underworld. Do bacteria condition the soil for earthworms? Do earthworms condition the soil for bacteria? We all know how vital the common angle-worm is in the maintenance of soil fertility. It aerates and pulverizes the soil. It actually produces topsoil. It eats insect larvae. Without this little subterranean creature soils would be relatively hard-packed. It is nature's plow. It would seem to me that here is a powerful team, the microbe and the earthworm, evolved by nature to condition the soil, to prepare the seedbed, to feed the plant, to dispose of plant residues.

Now, bacteria will work only in an alkaline medium, so nature has made the earthworm's intestinal system alkaline. Man and all animals have an acid digestive system. When a bacteria enters a man's stomach the powerful acid juices spell his doom. Can you imagine what would happen if the earthworm's digestive system was acid? Since the earthworm eats the soil, ejecting it in the form of castings, and since the entire topsoil passes through their bodies every few years, they would soon destroy all the soil bacteria. But fortunately this does not happen. In fact as the bacteria go through the earthworm's digestive tract they may even multiply and the castings of this little creature may contain more bacteria per gram, than the soil surrounding it. I don't know of any bacteriological studies of earthworm castings but they should be made. It has been shown that the earthworm takes soil as food and treats it with secretions of its digestive system. When it passes it in the form of castings, studies have shown that it is more alkaline than the original soil it ingested.

The earthworm definitely helps bacteria by boring into the soil and keeping it well aerated, a condition which permits soil microbes to multiply. Such a porous structure permits water to penetrate and to maintain a moist condition so necessary to bacteria. Do the microbes represent food for earthworms? We know that protozoa feed on bacteria and in dying contribute the combined amount of plant food representing both organisms to the soil.

Earthworms also ingest fungi and although the latter can live

either under acid or alkaline conditions, investigations should be made as to the effect of their passing through the earthworm's digestive tract. It is remarkable how nature makes things foolproof. She gives us two kidneys although we need only one, keeping one in reserve as a safety factor. She has acid-loving as well as alkaline-loving microbes in the soil. In the event the balance is upset the soil routine can go on until conditions right themselves.

The power of "digestibility" of the soil is in direct relation to the amount of microbes, earthworms and other forms of life contained in the soil. The power of "digestion" means the ability to break down organic matter such as manure, green matter, etc. I have heard of a case of a man who obtained some nice-looking topsoil that had been thrown out of a green-house. He had dissapointing crop results with it, the poorest he had ever had. On checking he found that it had been sprayed and chemicalized to within an inch of its life. That soil had indigestion. If he could have had a bacterial count made it no doubt would show very low figures.

The same principle follows with cover crops that are plowed under for the purpose of furnishing fertilizer material. Farmers are sometimes greatly disappointed over the meagre crop yields following such an operation. The reason is in such case that the soil is not fertile and very low in bacteria and fungi. The bacteria, in having to break down so large a quantity of green matter, must use up a large amount of nitrogen stored in the soil as their energy food, with the result that there is not sufficient left for the growing crop. The year following they may benefit, however, because the dead bodies of the microbes, enriched with this nitrogen, are available as fertilizer material.

There have been cases where soil is so remarkably fertile, and therefore full of bacteria, fungi and earthworms that a gunny sack placed on the soil would disappear in several months. On unfertile soil it could lie undigested for years. In a very fertile soil a green cover crop would be easily assimilated quickly and thus benefit the current crop. Placing strong "antiseptic" chemical fertilizers in a soil will certainly not help its powers of digestion. In fact it will reduce them substantially.

In the same article mentioned above, Dr. F. B. Smith says, "It is not at all unreasonable to expect new soil management practices, cropping systems, rotations, more intelligent use of green manures, manures and fertilizers based on microbiological action in soils when sufficient information is at hand concerning the effects of these treatments on the complex soil flora and fauna and the biological interactions in the soil."

I believe that Dr. Smith is hinting at the possible elimination of any fertilizers that would have an inhibitory influence over soil microbes. This would mean only one thing — the eventual discontinuance of such strong chemicals as ammonium sulphate, nitrate of soda, superphosphate, etc.

J. I. RODALE.

Sunflower Seed Registry

Will all those who are growing sunflower seeds for sale advise us of the number of acres they have in this crop and the history of the fertilizer practices followed. Any readers who desire to purchase seed grown organically should advise us at once. We will try and arrange such purchases. Sunflower seeds are a miracle-food and should be eaten by every one.

AGRICULTURAL EDUCATION

A Letter To The Editor Of The LONDON TIMES (Feb. 28th, 1944)

A school in Ireland grows food the organic way—with a general improvement of the health of its students.

Sir,—One of the many problems which will confront us after the war and should now be given serious thought is that of the soil —the basis of human life. We are told that more fertile land has been lost by soil erosion since 1914 than in the whole history of mankind. This is not confined to the western hemisphere, but is also happening in Australia, Africa, China, and Russia, with determined efforts in the United States of America being made to stem the tide of advancing erosion. Much (though not all) of this recognized calamity has been caused by man's destructive activities. We all know of the over-cultivation, deforestation, and non-conservation of the rain-water supplies, bringing sheet and gully erosion in nearly every country in the world.

Though our islands are not turning into deserts, there is a serious and progressive loss of fertility and a corresponding increase in disease among the plants and animals which provide our food. The majority of our city dwellers are unaware that the earth on which they depend for life is being slowly but surely done to death. But the comparatively few who study the problem tell us that the way to a healthy soil, which in turn will give us healthy plants and animals, is not by artificial means but by the return of all natural organic waste to the land.

Surely this is now an urgent and vital problem? Have we not an obvious duty to perform? In the reorganization of education we humbly submit that some provision should be made for the practical teaching of agriculture, arboriculture and horticulture on a wide scale in many of the schools, which have the good fortune to be situated in country districts, so that boys and girls, who will not necessarily become farmers, may have some knowledge and appreciation of this all-important problem. Agricultural education should not be left to the specialist students in colleges given over to that purpose, but should have a far wider circulation.

May we quote from our own experience as Fellows of the College of St. Columba? This college, one of the smallest public schools, recently acquired some long-neglected land, and with its own small property established a profitable mixed farm. It is worked by a committee of masters, boys and workmen. Much of the work is done by the boys, working with carefully selected men, none of it during class hours. The greater part of it is practical manual work in the open air. Once a week boys voluntarily attend agricultural lectures in the biology laboratory.

All farm, garden, and house waste of an organic nature is turned into compost. Over 100 tons was made last year. The soil is continuously being enriched, while drainage, weeding, animal husbandry, and tree planting are methodically carried out. Not only is the school provided with fresh vegetables, milk, beef, mutton, and wheat, but the general health is noticeably better with a greater immunity from infectious disease. Also, the standard of work, judged by public examination, is improved. We should mention that all surplus farm produce in the holiday periods finds a ready local market. The College of St. Columba has no reason to regret the experiment. For these reasons we would submit this information to your valued paper.

We are, dear Sir, yours faithfully,

Arthur Dublin, Archbishop;
Iveagh; E. H. Alton; Roland L'E. Bryce; C. M. Dobbs; Hugh A. C. Maude.
St. Columba's College, County Dublin.

MORE PLANTS FROM LESS SEEDS

BY ROGER W. SMITH

THE good vegetable gardener desires above all a fine stand of healthy vegetables. He suspects his seed of being of rather low viability in spite of the statement on the packet. He considers the problem of "to thin or not to thin" the resultant seedlings. He knows that some seed must of necessity fail because of tiny inequalities in soil conditions. He notices that Nature sprinkles seed with extravagance. Garden books generally seem to advocate rather thick sowing and later thinning. But good seed is often scarce and expensive. How then is he to proceed?

Pondering this matter of thinning, he recalls that radish seed is often very thickly sown and thinning accomplished by pulling such roots as mature. Carrots, beets, and even turnips, are also frequently thickly sown and thinned by pulling roots as fast as they reach edible size. What are the value of these practices? What effect do they have upon the amount of healthful, edible foodstuffs produced from a given amount of seed?

To understand what happens when seeds are thickly sown and the seedlings later thinned, it is necessary to have a clear picture of the plant in its entirety. Radishes are most commonly used to demonstrate the "thinning by pulling" idea. Compared with other root crops the fleshy roots of the radish form with great rapidity. But the small fleshy root stalk and the leaves which reach a few inches above the garden surface are but a part of the growing plant. The roots of the radish by the time the plant reaches the flowering stage—the same season the seed is sown—often penetrates to a depth of seven feet to form an inverted, bush-like growth of fine roots having a spread of over eight feet.

It is thus apparent to what extent these great subterranean networks of fine roots must overlap when radishes are thickly planted even though the root systems of young and immature plants may not have reached nearly their maximum size. The interlacing of the roots of the same kind of plants often produces the most dangerous competition because all roots under these conditions seek approximately the same kind of plant nutrients.

It is likely that the great diversity of plants growing together in the wild are the result of the avoidance of this kind of root competition.

Thus the good gardener will sow seed very carefully and thin seedlings when necessary with regret. The practice of sowing more seed than is really necessary and later laboriously thinning the excess seedlings is to be avoided for even small root systems may not be torn apart without severe damage to the remaining plants. The modern idea is to sow thinly in the row a given number of seeds to the inch of row so as to reduce the necessity for thinning. Whatever seedlings must be taken out should be lifted as early as possible, preferably when the soil is moist and when their removal is least likely to injure the poorly branched root systems of those plants remaining.

In this connection it is quite likely that much of the damage done by weeds is caused not so much by their above ground competition as by the root disturbance which often results when they are pulled.

The fallacy of the "not to thin" idea may be easily shown by thickly sowing a given number of radish or carrot seeds and thinly sowing an equal number. The resultant crops will clearly demonstrate that more and healthier plants result from seed thinly sown and well spaced than from that thickly sown.

The important effect of root disturbance is shown by two well established garden practices. In the fall maturing cabbage heads are often partially pulled, bent over or twisted, during a late rainy spell to partially disconnect the root system and thus prevent too rapid absorption of moisture which might cause a disastrous cracking of the heads. Root pruning is used to throw such plants as the wisteria into bloom, which of course is quite the re-

verse of what is usually wanted with most garden vegetables.

Much seed can be saved by proper sowing and careful spacing. When sowing hills the seeds should never be placed in a tight group. It is almost impossible to remove quick growing seedlings of squash, pumpkin, etc. without uprooting those that remain when they are close together. The same difficulty is encountered when thinning thickly sown beans.

Skill in sowing comes with practice but every good gardener may reap the rewards that come from being careful. Large seeds of limas should be placed with the eye downward. Onion sets do much better and develop more uniformly when set in their natural position than when scattered along the drill. Fine seed such as carrot, lettuce, endive, onion, etc. is easily and evenly sown if it is mixed thoroughly with clean, dry sand and the mixture sown in a thin line along the drill. The wider the line of sand the thicker the seedlings will stand.

Sowing seed thickly is wasteful. It seldom overcomes losses brought about by sowing too deep or too shallow. It will not make up for a poorly made seed bed, improperly pulverized soil or soil lacking in mellow organic humus. It will cause a lot of laborious thinning. It may even in extreme cases, result in another crop of seedlings breaking through after the thinning has been done.

The good gardener has faith in his seed. He sows it with care and avoids overcrowding the seedlings. He knows that long before they reach maturity healthy plants tend to fill small intervening spaces and thus present a uniform, uncrowded stand.

SPRAY POISONS KILL BEES

From "BEE CRAFT," (England)

FOR many years we have heard of the value of bees for pollinating fruit blossoms. Bees have been bought by fruit growers solely for this purpose. But now comes another story. The bug-killing mania has so far developed in some places that it has proved impossible to keep bees near them. Arsenical dustings and washes, applied during the foraging season, have wiped out the whole of the flying population of large apiaries. This is due to the presence of arsenic or other poison, not only on the fruit blossoms, but on leaves, and on ground flora — dandelions, clovers and other plants visited by bees for water, nectar and pollen. We hear of large apiaries that have been virtually wiped out, and a potential bumper crop of honey turned into a dead loss, solely from this cause. The result is that the bees are being removed from the vicinity of the orchards in question, and the growers must hope that enough humble bees and other insects will set his fruit for him before they too succumb to his poisons.

Some of the blame may be attached to Government County Council, wireless and newspaper "experts." A lot of people are so innocent that they believe an "expert" really knows something about his job, so, when he advises the use of some lethal preparation to kill a bug whose presence is problematical, they follow that advice, instead of spending the money on manures (*sic*).

Financial interests are concerned in the production of insecticides, and "experts" are not forgotten by the sales managers of those concerns, who keep them well informed of the merits of their products. The bee industry has failed to present the other side of the picture, until the situation has become acute. A joint meeting of the B.B.K.A. and representatives of the un-affiliated bodies in 1940 sent representations to the Ministry of Agriculture, and also to Imperial Chemicals Industries suggesting investigation of various problems that might yield a solution short of removal of large numbers of apiaries from commercial fruit growing areas.

People who have purchased stirrup pumps will use them for spraying crops that have never been sprayed before, and unless they are correctly advised they may do a lot of harm by upsetting the balance of nature by killing the natural enemies of the pests, as well as pollinating insects.

How To Economize On Fertilizer

A series of articles by the famous leader of The School of Living, Suffern, N. Y.

BY RALPH BORSODI

Part 2

THE following directions for manufacturing humus in compost heaps represents an adaptation to American conditions of various experiments with the Indore Process. Humus has been satisfactorily made in compost heaps such as those here described by the School for many years.

Seven classes of materials enter into the process of manufacture:

1. *Plant or Vegetable Wastes.* Weeds, leaves, corn stalks, old straw, water reeds, seaweed, lawn and hedge trimmings, vegetable garbage, saw-dust and wood-shavings, tree prunings—in fact any and every available kind of waste material of vegetable origin. Stiff and woody materials such as corn stalks, prunings and reeds should be thoroughly crushed or shredded or they will decompose very slowly and slow down the fermentation of the whole heap. Fresh green material should be permitted to wither before going into the heap since it is humus, and not silage, which is being manufactured. Approximately 60 per cent of the heap by weight should be composed of these vegetable wastes.

2. *Animal Wastes.* Cow, horse, pig, poultry, sheep, or any other manure, is essential to produce humus of the highest quality. Garbage, composed of meat scraps, including bones, (preferably crushed), dead animals of any kind, dried blood, slaughter-house refuse, fishery wastes are very desirable. About 40 per cent by weight should consist of animal manure and wastes.

3. *Activating Agents.* Urine is by far the best activating agent because, apart from its other mineral constituents, it contains the valuable combined nitrogen required by micro-organisms when breaking down plant materials. Where livestock is stabled on dirt floors, the earth in the stalls should be periodically replaced and the urine-saturated earth used in the compost heap. All bedding saturated with urine should also go into the heap. Where concrete or solid floors are used, provision should be made with gutters for drawing the urine into a pit where it can collect and be pumped out when needed, perhaps with an old pitcher pump. Or the pit may be filled with loose earth and the urine-saturated earth shoveled out when needed. It is true that the decaying remains of animals, particularly their organs and intestines, are also excellent activating agents, but every drop of urine which can be accumulated should be saved for this purpose. The proportion of urine to manure which is ordinarily accumulated in a good index of how much urine should be used. The speed with which decomposition takes place is very largely determined by the quantity of activating agents used.

4. *Neutralizing Agents.* Some material such as wood ashes, limestone, hydrated lime, sea sand containing fragments of shells, powdered chalk, mixed with earth, is needed to reduce the excessive acidity which would otherwise develop in the heap. This acidity must be neutralized or the micro-organisms cannot ferment the mass at high speed.

5. *Earth Seals.* The heap must be sealed or covered all over, preferably with earth. Only enough earth should be used to kill all odors but not enough to prevent aeration.

6. *Water.* In most sections of the country, rain will provide all the water needed after the heap has once been made. Rain is the most desirable form of water because it is really a saturated solu-

tion of oxygen. In dry weather, water should be added; the heap should be kept moist but should not be soaked. When water is added, it should be sprinkled on the heap.

7. *Air.* Air is an essential ingredient because it is needed in large quantities by the fungi and bacteria which make the humus. If the seal of earth on the heap is not too thick, and the heap is not a very large one, all the air needed will seep in through the seal. In large heaps, air-holes three or four inches in diameter should be punched with a crow bar every four or five feet through which air can be drawn into the center of the heap.

Locating the Heap. Compost heaps may be located in any convenient place—near the barn where the manure accumulates or at the edges of the fields where they are to be used. It is exceedingly desirable to locate them under trees or in shady places as this checks evaporation of the heap in dry weather and also protects them from beating rains. If located in the open where the sun beats steadily upon them, it is more necessary to add water in order to maintain steady fermentation.

Preparing the Ground. The heap should be located on the ground, and preparation consists merely of digging down about six or eight inches over the area which the heap is to occupy. The sod obtained in clearing should go into the heap to be decomposed; the rest of the earth from the excavation should be piled on each side to be used for sealing the heap.

Size and Shape of Heap. A compost heap is a mound which may be of indefinite length. If they are to be made under the shade of a tree, several heaps may be made each not less than three or four times as long as their width. The minimum width should be five feet. Where plenty of material is available, the width should be increased to 10 or 12 feet. Heaps too wide interfere with the necessary aeration. The height should be five feet to begin with; after decomposition the heap will settle down to a height of about 30 inches. A broad base should be made of the top sloping toward the center to help catch and hold rain water. The sides should slope just enough to hold the earth seal on the sides.

Making the Heap. The heap should be built in layers like a sandwich—a layer of six inches of mixed vegetable wastes; then a layer of one or two inches of animal manure; then a good sprinkling of whatever is used as neutralizing agent, earth mixed with lime or wood ashes. If the material is not very moist, water should be sprinkled on as the heap is made. This is where to use urine if you have it. This process can be repeated until the heap has been built up to the desired height. Considerable variation in the thickness of the layers is possible without any serious interference with the process of decomposition. The whole heap should then be sealed with a thin layer of not more than an inch of loose earth—the less the better. If it is desired to add to the heap daily or at regular intervals, one end of the heap may be left unsealed and covered temporarily with two or three thicknesses of burlap bags or any other material which will serve as a matting to prevent the escape of gases and odors and avoid attracting flies. When additions are made to the heap, the temporary seal may be removed; the additions then made and sealed except for the new end, and the temporary seal then placed over the new end. If no such temporary end-seal is available, a thin sprinkling of earth may be substituted. In making the heap, the mass should be kept loose and open to allow plenty of aeration. An intense fermentation sets in immediately after the heap has been made — the temperature rises to about 150 degrees F. and the vegetable matters turn white due to the development of fungi.

Sealing makes the entire process sanitary both from the standpoint of man and agriculture. The high temperature and humidity in the heap which continues for days destroys the eggs and larvae of flies and other noxious insects and in addition decomposes the seeds of weeds and spores of harmful fungi.

Turning the Heaps. After three weeks or so the heap should be turned over, beginning at one end and shifted, so to speak, three to six feet in the direction of the end at which the turning was begun. In turning, care should be taken that all undecayed matter which may have remained at the outer edges. is covered up and spaded into the center of the turned heap. About seven to 10 days after the first turn, the material begins to crumble and darken in color. Bacteria from now on take the leading share in the work of decomposition. In this first turning, a fork should be used and vertical slices of from nine inches to one foot of material taken at each forkful.

About five weeks after the first turning, the heap should be turned a second time. In the second turning, a spade should be used and vertical slices of about six inches taken. If for any reason fermentation has not proceeded rapidly enough, additional urine or urine-saturated earth may be sprinkled into the heap.

About one month later, or three months after the heap was

first begun, the humus should be ready for application to the land. It should then consist of a finely divided, earthy-smelling, material about 80 per cent of which should pass through a sieve with six meshes to the inch. If the fermentation has been full and complete, no remnants of straw or stalks should be present. The whole process should be speeded up as much as possible by keeping the heap moist, by adding urine diluted in water, and by turning as directed, in order to reduce the loss of plant nutrients to a minimum.

Time for Humus Manufacture. Humus is a living substance, and should be spread on the land as quickly as possible after it has been made. For this reason, the time when heaps are made should be fitted into the general operation of the farm. In the winter, when freezing makes it impossible to spread humus, the manure and wastes should simply be accumulated and sealed or covered over as much as practicable so as to prevent odor and loss of nitrogen until the time when the making of heaps begins.

It is important to use good judgment in fitting humus making into the ordinary work of the farm and care of animals. The accumulation of the material as well as the making of the heaps will not then seem to consist entirely of extra work. It will take the place, to a large extent, of the present work in handling manure and burning and disposing of what is now considered rubbish.

The Indore Process.

The Indore Process of humus manufacture was perfected at the Institute of Plant Industry in Indor, India, between 1924 and 1931. (1). Through years of experimentation and practical application in India, Africa and England, through writings and lectures, the process has spread with extraordinary rapidity all over the British Empire. Since 1931 the system has been adapted to coffee, tea, cotton and corn plantations and has demonstrated its practicability for almost every kind of agriculture. The reduction in fertilizer costs, the restoration of fertility to worn soils, the increase in yields, and the improvement and greater health of plants, has established its efficacy and merits.

In 1938 it was estimated that a million tons of compost were being made annually on tea estates alone in India and Ceylon. In 1935 an important group of estates in Ceylon reported the production and application of compost at an average cost of Rs. 2.87 per ton, or about 93 cents per ton. Howard says in a paper read before the Royal Society of Arts in November, 1935:

The large scale trials . . . . . initiated in Travancore leave little doubt that the introduction of the Indore method improves the fertility of the gardens and lowers the cost of tea production.

He states further:

Among the men engaged in the production and sale of tea an uneasy feeling can be detected that the use of artificial manures (chemical fertilizers) has been followed by loss of quality. (2).

Records kept by the manager of a coffee estate near Kyambu, Africa, show that 1,660 tons of compost were manufactured and applied to the land of this estate in 28 months. The complete cost was 4s.4d. per long ton, or only about 97 cents per short ton in our money. A letter from the manager to Sir Albert Howard states:

You will be glad to know that your process is spreading rapidly in these parts (East Africa) and has now become recognized routine practice on most of the well conducted coffee plantations. The cumulative effect of two years on my plantation is wonderful.

These reports indicate clearly that not only is the process adapted to intensive, small scale gardening, but that it is also practicable on large farms where special cropping conditions are involved. The Indore Process is not, of course, the only process of organic farming which has been well developed and about the efficacy of which there is ample evidence, but it is the simplest and most economical in the judgment of the School. (3).

(1) The Indore Process is described in detail in "The Waste Products of Agriculture," by Albert Howard and Yeshwant D. Wad, 1931; and "An Agricultural Testament," Albert Howard, 1940.

(2) "Journal of the Royal Society of Arts," November 22, 1935.

(3) The Bio-Dynamic method is another method of manufacturing humus on the farm. Developed by Dr. Ehrenfried Pfeiffer, Director of the Bio- Chemical Research Laboratory, of Dornach, Switzerland, it has become well known in Switzerland, Germany, Holland and other countries. The method differs from the Indore Process in several ways: the animal and plant refuse are composted in separate heaps, and each is treated differently. Lime is used to neutralize acidity in the vegetable compost heap. Decomposition is hastened and presumably improved with ferments or preparations made from medicinal plants such as chamomile, milfoil, valerian, dandelion, etc. The formulas used are revealed only to members of the association promoting the process. Quartz and other sprays are also used on the heaps and in the fields, and are an integral part of the fertilization process. Manure heaps are made into humus in from four to eight weeks; plant heaps require from eight to 12 months depending upon the season and temperature. Liquid manure, carefully preserved in barrels down in the ground outside of the barns, is also treated with the preparations and used then to moisten the composts. While the Bio-Dynamic method is an organic system similar in its essential principle to that of the Indore Process and the methods of humus manufacture in the Orient, it is more complex, involves much more labor, and is not as economical as the Indore Process.

Cinderella Lily Now a Princess

BY CARROLL ABBOTT

Reprinted from NATURE Magazine.

This is one of Mr. Russell's favorite creations, "Annis Victoria Russell," a giant yellow lily that may have thirty buds to a stem. This hybrid daylily came from other hybrids to produce a striking and beautiful plant. As many as five thousand crosses may be made in the task of producing a new sort. This takes time and patience, and there are many daylilies that have to be discarded or used to feed the horses in the process.

GLIMPSING possibilities of hidden beauty and variety in the common, orange-colored daylily, H. M. Russell started on a quest nearly a quarter-century ago. Today he is the creator of more than two hundred commercial varieties of the daylily, or *Hemerocallis*. Other sorts grow on his twelve-acre farm at Spring, Texas, where there are more than half a million daylily plants.

Through skill and patience, Mr. Russell has produced a wonderful array of flowers that will flourish as a living tribute to his work. Also he has prospered, unlike many other famous plant breeders, although he seems to have little interest in the financial reward except as it permits him to carry on.

For a long time the daylily has grown in alleys, ditches, weed patches and back yards, largely ignored and a Cinderella plant. Its color pattern was not attractive or exciting, and few people saw in it any possibilities as a princess among plants.

Yet from this modest flower Mr. Russell has produced solid-colored lilies of mahogany, carmen red, chartreuse, peach, rose, pink, cream, chrome, wine, and purple. There are lilies in lovely wood shades of gentle rose-brown, with darker brown veins and yellow midribs that melt into a yellow throat. Many of the hybrids have beautifully contrasting veins, midribs and eye zones at the base of the petals. In the bicolors, there are hybrids with such marked contrasts as rose and lemon, violet-reds and yellow, raspberry and lemon, purple and yellow. In size the blooms range from that of a jon-

quil to the dimensions of a salad plate.

H. M. Russell was one of the first five men to pioneer the hybridization of daylilies. While he was doing general nursery work in Alabama, Georgia, and South Carolina, he was also crossing daylilies, and his first hybrids were sold for planting on large estates. Today he is believed to be the only man to make his living solely by selling daylilies.

Mr. Russell was born in Wheatland, Indian Territory, in 1901. When he was four months old, his father died and left him with nine other brothers and sisters. His father was a plant breeder in a modest way, for it is on record in Tallapposa County, Alabama, that he produced forty bales of cotton on fourteen acres of unirrigated land from a variety he originated himself.

Before Mr. Russell finished the sixth grade, he went to work, and for twenty years engaged in general nursery work. It was not long before he realized the latent possibilities of the daylily and began his hybridizing in a small way. He went from Alabama to South Carolina, virtually with a lily on his knee.

While living in Sumter County, South Carolina, Mr. Russell learned that a grower in Virginia had a rare lily. When he visited the garden, a closed bud was given to him. With the bud he raced five hundred miles, driving all night, so that he would be at home with his lilies when the bud opened. He made it, and used the flower the next day to pollinate a number of liles. This experiment led to the development of his midget varieties.

In telling of his work in the breeding of varieties that remain open at night, Mr. Russell says, "I found a little old lily that didn't close at night. That was my beginning. This silly little thing was just like a Chinese laundry. I'd go there at midnight and it would be open. When I returned at noon the next day, I'd find it closed." This "silly little thing" he regards as among the greatest developments in horticulture in recent years.

The early days were hard going, and more than once Mr. Russell was urged to sell the stock of his finer hybrids to the larger nurseries for distribution. He steadfastly refused. The vision that saw undeveloped colors and hidden sizes also saw the day when he would be able

H. M. Russell and an admirer of daylilies inspect an array of some of the new hybrid giants and bi-colors that he has produced. Some of the bloom in this collection are as much as nine inches across.

to supply America with the finest in daylilies.

Six years ago the hybridizer moved to Texas to take advantage of the longer growing season. He abandoned all other work and went in exclusively for the breeding and growing of daylilies. Spending several years in collecting species, as well as the finer hybrids, Mr. Russell traveled as much as 19,000 miles on a single trip in completing his collection.

In 1941 he used twenty-seven thousand hybrids of his lilies on four landscape projects. Eleven thousand were used to add to the beauty of the Charles Urshel estate in Oklahoma City. The past few years have been spent in breeding for giant bi-colors and early-blooming varieties in darker colors.

Formerly the only early-blooming *Hemerocallis* was a yellow dwarf named Flava. Using this early bloomer as a parent plant, Mr. Russell made 5000 crosses. Now he has reds and purples in the early-blooming class.

His next catalog is scheduled to come out in blazing color. This spring visitors to his fields will have an opportunity to see a tremendous mass of daylily blooms, as each plant produces a multitude of blossoms.

Mr. Russell's originations have been given many romantic names such as "Painted Lady," "Old Vintage" and "Trail Blazer." Some have colorful histories. Once when Mr. Russell was vividly painting a glowing word picture of one of his unnamed hybrids, a friend asked, "Can I quote you on that?" "Certainly," replied Mr. Russell, and dubbed the new hybrid "Quote Me." Thus are flowers often named.

With so many thousands of hybrids, naturally all will not win the approval of the horticulturist. These undesirables therefore must be eliminated. One way was to dig a large pit and bury them, but this took time and money, so he now merely fences in the field of useless hybrids and turns the horses, pigs, and geese in to eat. It is a neat, clean, and economical solution.

"With so many hybrids it is difficult to pick my favorites," states Mr. Russell. However, he gave in and picked as his color favorites, "Tejas," a glowing red, and "On Tour" and "Mrs. B. F. Bonner" in the pale lemon class, "Purple Waters," a deep rich purple. "Annis Victoria Russell," a giant with as many as thirty buds to a stem, was his favorite yellow. "Queen of Gonzales," which has flowers remaining open two days and a night, is his best chrome.

Recently Mr. Russell attained a high point in his useful career. He was proclaimed by the daily newspapers to be an industrial asset to his city of adoption, industrial Houston, twenty-three miles away!

Black Bread For Vitality

IT was Grantland Rice who some years ago went on a voyage of discovery to find what kind of foods the All-American football team was fed. To his great amazement he found that all of them were black-bread eaters.

Recently I heard the comment over the air that the Russians are starving for all foods but their basic black bread. The world wonders how it is that the entire Russian nation can endure such terrible physical trials and come through in such fine shape.

From the foregoing do not misunderstand that I am in favor of rye as a diet for man in the place of wheat. But I do draw your serious attention to the fact that rye bread is so vastly superior to our maltreated wheat breads that we as a race, physically, are inferior to the Russians.

Another good food we never use is flax. Although classed as a grain it is really a very small nut. A tea or gruel from flax makes a most excellent substitute for milk and eggs in cakes, cookies, muffins and buns. It is particularly good for old people and those who are allergic to milk and eggs.

For years I have been asked how I am still able to do heavy manual labor, though long past my three-quarter century mark. The fact that I eat black-rye bread and grind up my own wheat fresh in a mill that resembles a coffee grinder may have something to do with my ability to do without help on my thirty-five-acre experimental farm.—George H. Corsan.

Hints For The Victory Gardener

This is the nineteenth of a series of articles by this author dealing with the cultivation of ordinary vegetables.

BY ROGER W. SMITH

CUCUMBERS

FEW salad vegetables have greater appeal to the Victory gardener than the cucumber. Its food value may be slight, it may not have much commercial importance, but its sentimental attraction is undoubtedly very great. You will think with pride of the fine, smooth cucumbers you grew in the small space set aside for them.

The origin of the cucumber, *Cucumis sativus*, L., is obscure. The cucumber was undoubtedly well loved in ancient times but modern plant explorers have so far been unable to locate its wild prototype.

You will likely think of cucumbers as belonging to two main classes, the large, slicing type and the small, pickling type. Slicing or salad cucumbers are usually smooth and free from spines whereas pickling or gherkin cucumbers are often thickly covered with thin spines.

How can you raise a crop of cucumbers without too seriously encroaching upon the limited space of your garden? A very simple method is to select an open, well drained spot preferably off to one side of the garden where the growing of cucumbers will not interfere with the cultivation of row crops. Cucumbers thrive in soil that is not excessively acid and which is well pulverized and quite porous. They require an abundance of plant nutrients plus moisture. For this reason the area selected should be well prepared and its quota of humus heavily increased by the digging in of a generous amount of compost humus, well rotted manure, or other suitable organic materials. Commercial growers of cucumbers apply as much as one hundred tons of well composted manure to the acre.

Where the hills—groups of plants—are to be formed, butter tubs with the bottoms removed, or boxes with both ends removed, should be securely placed, spaced about five feet apart each way, and filled with mature compost humus. After all danger of frost has passed and the ground has warmed up, cucumber seed should be thinly planted close around the tubs, covered with a half inch of sifted compost humus, and well firmed.

The contents of each tub should then be well watered and a thin layer of top soil applied after additional humus has been placed in the tub to make up for the settling of the original contents. The water, passing through the humus in the tub, will find its way to the area immediately around the tub in a steady, natural manner. Additional water should be poured into the tubs during the growing season whenever necessary to keep the area moist.

Although compost grown plants are very resistant to plant disease, it is prudent to get the cucumber seedlings off to a good start. It is best to protect them while they are very small from the attacks of cucumber beetles. These beetles not only feed upon the plants, often they introduce serious plant disease. A very easy method of shielding the seedlings from cucumber beetles is to stretch cheese cloth from the top of the tub to the ground so that it encloses the plants in a small tent. Cucumber beetles easily pass through mosquito screen and any fabric heavier than cheese cloth excludes too much light. If a little earth is drawn up over the bottom edge of the screen, the beetles will be effectively prevented from gaining entrance by burrowing.

As soon as the plants begin to crowd, the covering should be removed, and when they are about four inches tall they may be thinned to about five plants to each tub. A couple of dozen

properly grown plants will provide you with a surprising number of fine cucumbers.

Cucumbers demand an adequate supply of moisture. Just as soon as the plants are well grown, the soil surrounding them should be covered in some way to prevent too rapid evaporation of soil moisture. This may be effected in a number of ways. Straw may be used as a mulch, even boards or old sacks. Probably the best material to use is a heavy mulch of rough, dry compost, for this material will also supply later plant nutrients to the roots of the plants. But whatever method you decide to use, you will apply it best if you understand that its purpose is to prevent the drying out of the soil and to keep the developing cucumbers from direct contact with the ground.

Cucumber may also be grown in hills without the aid of tubs. In this case a large quantity of compost humus or well rotted manure is applied so that it forms a distinct mound and given a shallow covering of top soil. Usually the plants are thinned to stand three to the hill.

Field grown cucumbers are often trained to cover low "A" shaped trellises placed between the rows. The flowers which form on the outside of the foliage set fruit and the weight of the fruit gradually causes it to sink through the foliage and hang down on the underside of the trellis.

Beside the vine types of cucumbers there have been developed many bush types which will grow when planted in furrows. The bush cucumbers are usually grown eighteen inches apart in the row with the rows two feet apart.

When you attempt to decide which of the many strains of cucumbers you should plant, you will be faced with a happy problem. In general all modern strains of slicing cucumbers are derived from the old "White Spine" variety. But whether you grow such fine salad cucumbers as Black Diamond and Sunnybrook, both of which mature their fruits in sixty days or less, or whether you plant one of the spiny, pickling strains, West India Gherkin or National Pickling, which mature a large crop of relatively small cucumbers in about the same length of time, you will find much satisfaction in the growing of them.

Cucumbers of most strains, whether slicing or pickling, should be gathered while they are still deep green in color. If their harvesting is delayed they tend to develop a yellowish hue, an indication that they are overripe.

You may chance to compare your own home-grown cucumbers with those huge cucumbers produced in greenhouses. Growers of greenhouse cucumbers use special strains to secure their two-foot-long s l i c i n g cucumbers. These strains have been developed because of their ability to set fruit without normal pollination —parthenocarpic. In spite of their appearance you will most likely prefer to produce in your own garden more natural cucumbers, those that have known the warmth of the sunshine and the pleasant hum of the bees.

Seed of especially fine specimens of cucumbers may be easily saved by allowing the fruit to remain on the vine until it matures when it usually changes to a distinctly yellow color. The ripe fruit should be split, the seeds scraped out, washed and carefully dried.

But whichever of the many fine strains you grow, your experience in cultivating and caring for this homely salad vegetable will be a happy one and will almost certainly lead you to an interest in other more valuable members of the cucubits family, and to an increasing appreciation of the importance the principles of organic gardening play in normal, healthy plant growth.

Reduced Subscription Rate

Effective immediately the yearly rate of ORGANIC GARDENING has been reduced to $2.00 a year. All those who have paid the higher rate will have their subscription extended accordingly.

The Relation of Organic Fertilizers to Vitamines

(Extract from the Journal of the Royal Empire Society, England, Dec., 1934)

AT the meeting of the Planters' Group on November 1st, when Mr. R. D. Anstead, spoke on the relation of organic fertilizers to vitamines, Mr. W. G. Freeman, who presided, referred to the loss the Group had sustained by the death of Major H. Hely Pounds, one of its founders and a member of the Committee.

Mr. Anstead began by pointing out that manurial applications can react on plants not only by affecting the yield, but also by affecting the quality of the crop produced, and claimed that the first investigations made in the latter connection were initiated in the Madras Presidency. The discovery of this effect of manures on plants was, as is often the case with new discoveries, partly accidental. For some years a series of manurial experiment plots, sown with millet and wheat, had been maintained at the Agricultural Research Institute in Coimbatore, and in course of time it was found that the grain obtained from the different plots varied not only in quantity, but in quality, and that when seed-grain from the various plots was sown and maintained under identical conditions, a better crop was always obtained from seed from the plots treated with organic manures. Dr. McAlison, who was then working in the Madras Presidency on deficiency diseases, then experimented with the grain, and found that the nutritional value of the crop from different plots varied enormously. He found, by experiments made on rats, that the vitamines essential to growth were missing from grain grown on plots without manure, or with applications of mineral manures, whereas they were present in grain from plots treated with organic manures. Other experiments have since proved that the vitamine content of the crop is directly controlled by the amount of organic manure used. It does not necessarily follow that the highest crop is best, for a heavy crop lacking vitamines will have a lower food value than a lighter crop containing vitamines. Thus, while by no means condemning mineral manures, the lecturer was of opinion that a basal dressing of organic manure should be the foundation of all manuring schemes. The plant does not manufacture vitamines, but obtains them from the organic manure, either direct or by the agency of micro-organisms. The question arises as to the part played by vitamines in the economy of the plant. There is a growing mass of evidence pointing to the fact that plants with a shortage of vitamines are liable to disease, and, among other instances, Mr. Anstead referred to the experience of vegetable and tomato growers round Maidenhead, who yearly depend more and more on mineral fertilizers and complain more and more of the incidence of plant disease. This is due to increasing vitamine shortage brought about by the decreasing use of organic manures. Thus, the production of crops of good quality and plants resistance to disease, are both dependent on the existence of an adequate supply of organic manure, which, in these days of mechanization, is diminishing and becoming more expensive. The maintenance of adequate supplies is essential, and much work has been done in connection with this problem, which is to be dealt with by Sir Albert Howard, C.I.E., M.A., in an address to the Group at the January meeting.

Mr. W. G. Freeman expressed his admiration of Mr. Anstead's attractive presentation of the subject. Could Mr. Anstead say whether organic manures encouraged the increase of any particular vitamine, or a general increase in vitamines? Cases existed in which an apparent increase in vitamine content appeared to have accompanied the use of mineral manures, and Mr. Freeman cited experiments on the Winesap apple reported in the "Journal of Agricultural

Science" some two years ago. In this case, when five grammes of apple were eaten per day, there was distinct protection from scurvy in the case of the manured apples; when, however, ten grammes were eaten per day, protection occurred with apples from both manured and unmanured trees. This raised the question of the amount of vitamine necessary. A crop of very low vitamine content might yet contain sufficient for all practical purposes.

Mr. Birch, a coffee planter from Kenya, said that there is a considerable opinion that the flavour of coffee is no longer what it used to be, and remarked on the fact that the use of mineral manures for coffee was now general.

Dr. Tempany, Director of Agriculture, F.M.S., said that Mr. Anstead had put forward a new point of view, and a very suggestive one. The fact of the vitamines being elaborated in the organic manure, and passing into the plant by way of the root hairs, would be very difficult to prove. He was of opinion that organic manures are of much greater importance in tropical agriculture than in temperate regions. In the F. M. S. they had a sandy horizon on a quartzite formation, which becomes infertile after cropping for a few years. Organic manures, however, bring it round.

Mr. Hamel Smith, Editor of "Tropical Life," was convinced that sugar is no longer so sweet as it used to be. Presumably the sugar planters were using the wrong manure. Irrigation, while giving good crops, was yet apt to give a crop of poor quality. He thought irrigation perhaps washed the bacteria from the soil.

Dr. Tripp, Editor of "The Empire Journal of Experimental Agriculture," said that by quality Mr. Anstead appeared to mean nutritive value. There is as yet very little quantitative evidence of the relationship between vitamines and organic manure. A further property of organic manure, additional to the presence of nitrogen, potash, and phosphoric acid, is its effect on the texture of the soil.

Captain O. H. Cooke wondered whether the lecturer would ascribe the poverty of the cattle in India, to any extent, to the fact that the cattle manure is used largely for fuel and for houses instead of going back to the land? If so, would it be the case that the manure from such cattle would be of less value as a source of vitamines?

Mr. Anstead, in reply, admitted that the study of vitamines is extremely difficult and highly technical. It is present in very small quantities, and methods are complicated. The importance of vitamines is probably greater in places on the outskirts of the Empire, whose inhabitants are confined to one staple food, than at home where there is considerable variety, but even at home, the subject was now of importance from the point of view of the proper nourishment of the unemployed. Lack of vitamine caused deficiency diseases. As regards proof of the fact that vitamines are taken up by the plant, it had been done by growing the plants in water culture and adding such substances as yeast and organic manure, containing vitamines. The poverty of the cattle in some parts of India was undoubtedly due to lack of organic manure, but the value of cattle manure was not dependent on the vitamine content of the food of the animal. The action of micro-organisms was the starting point in the elaboration of vitamine in the manure, as had been shown by Rowland and Wilkinson. In China, where organic manure had been extensively used for centuries, one never hears much of plant disease.

Composting Results

Will any readers who have had results with the use of composts, both in farming or gardening, whether good or bad, write us about it? This information is needed in the preparation of an important book on organic methods of farming and gardening.

Unexpected Dangers From Monkeying With Nature

BY EARL A. GRAHAM,
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DISASTROUS CHANGES THAT HAVE FOLLOWED MAN'S WELL-MEANT BUT IGNORANT OR RECKLESS DISTURBANCE OF HER BALANCE AND TURNED FERTILE LANDS INTO DESERTS.

IN ancient days men dared not fell a tree or touch a spring, for fear they might invoke the anger of some disturbed tree spirit, spring fay or other lesser god.

Nowadays engineers hesitate at nothing. There is a plan to lower the level of the Mediterranean Sea, but no one knows what that vast redistribution of weight may do to nearby volcanoes such as Vesuvius or to the great fault line in the rocks responsible for earthquakes in Greece and Italy.

Vast power and irrigation projects have been begun on Western rivers, with no one worrying much about possible effects on weather or soil. Even damming the Gulf Stream has been proposed; although, as yet, nobody has taken that one very seriously.

In Congress new debate is promised over the proposed ship canal across the State of Florida, although many competent engineers believe that this may damage the State's water supply and make far more trouble than it does good. Others feel so strongly about it that they call it "cutting Florida's throat."

Nature is long-suffering, but there are plenty of instances to prove that she can strike back when she resents too much these various face-lifting operations; and can strike even more disastrously than the ancients imagined of their injured tree spirits or other offended gods.

One plan now being urged in Europe is to colonize again a part of the abandoned desert of Sinai, just south of the Holy Land. Probably this is a safe one, for a Roman colony of possibly 150,000 souls once flourished there on hills and valleys now completely desolate. All that is proposed is to restore this. But no one knows for sure what destroyed the prosperity of that once-thriving colony, what wrong guess or oversight of the old Roman engineers turned it into the desert that it is today.

For our own Florida project, there are engineers and geologists who maintain that the canal is among the most foolish kinds of Governmental foolishness, not only because it will waste millions of the people's money but ruin thousands of acres, possibly even hundreds of square miles of rich Florida land. Monkeying with Nature always is dangerous, as has been witnessed many times in human history by all kinds of projects from "reclaiming" land that turned out to be worthless to cutting down forests that everybody now would give millions to get back.

The idea in justification of this outlay of perhaps $200,000,000 of Governmental funds, is that a canal from Jacksonville on the Atlantic, to Port Inglis on the Gulf of Mexico would save nearly 400 miles for ships plying between New Orleans and New York by not having to go around

the tip of the Florida peninsula. Also it might prevent occasional wrecks due to hurricanes and running onto reefs on the East Coast.

In this case, however, the question is not so much whether this is just a gigantic boon-doggle or an equally great real estate scheme as whether it may have to be all filled in again to prevent a local catastrophe. Or even whether it could be filled in successfully if something goes wrong. It is entirely a problem of what will happen to the fresh water which at present lies so close to the top of Florida's soil.

One group of engineers thinks that nothing serious will occur. The arrangement of rock strata is such, they say, that the canal can affect, at most, only a few miles on either side of its course. Such beauty spots as Silver Springs, near Ocala, might be wiped out and water supply from wells along the picturesque banks of the St. John's River might be badly salted, but nothing worse.

Another group of experts representing the Geological Survey has stated that the canal might cause a "serious" depression of the water level which would extend fifty or sixty miles from the canal, taking in the coast even south of Daytona Beach. Still others are even more alarmed.

Florida gets most of its underground water, they say, from rock strata just underneath the surface of the soil. There are no high mountains in Florida to collect rain water and produce large running streams, like those of the more hilly States just to the north. Rainwater sinks quickly into the soil and runs off gradually into the sea. In some places in Florida there are underground layers of porous rock filled with rain-water accumulated from past years, or centuries, and which can be tapped by wells. No small part of the State's water, useful both for humans and agriculture, comes from these layers of water-filled rock.

If the proposed ship canal is dug, it will be filled, of course, with sea water, mostly salt. There is no thought of locks or other devices like those used in the Panama Canal, or other similar waterways, in which a part of the canal level is above the level of the sea and ships must be lifted from lock to lock as they pass through the canal. The proposed Florida Canal would be merely a great ditch dug across the State and allowed to fill up with sea water; diluted somewhat with rainwater, or other fresh water, picked up from the land surface or from lakes or the underground rocks.

One fear of engineers and geologists is that this pick-up of underground water would be disastrously great. In places the great ditch would cut through the upper layers of the rock underneath the soil. Any water stored in these rocks would be let out.

What is more, salt water from the ditch probably would get into these water-filled rock layers and spoil the fresh water already there by turning it more or less salty, as already has happened to many wells on Long Island and some in Florida itself.

Whether or not these disasters actually would happen is admitted to be a matter of opinion. Yet it must be admitted that equal disasters have happened in other similar instances.

The spectacle would be disconcerting to the most earnest believer in public works or in using Federal funds to change the condition of some part of the country. Instead of a winter playground for the whole eastern part of the continent, parts of Florida might well become a salty desert.

Even in this area deep water supplies might persist or individual communities might be able to store rain-water and still have some of it left for irrigation. Water for drinking might be provided, as is done in waterless Bermuda, by catching the rain-water from roofs, or by special methods of taking the salt out of the water of the sea, or out of the fresher but still salty water that would be in the proposed canal.

But much of Florida as a natural Paradise would be a thing of the past.

Since the childhood of the race, mankind has been playing with water as well as fire and with surprisingly disastrous results right up to the present scientific day. Some of man's most ghastly failures at "improving Nature" have been through tinkering with the water supplies.

For instance, nothing could seem more sound and sensible than modern irrigation, yet it resulted in poisoning hundreds of square miles of once fertile land in California, New Mexico, Arizona and other parts of the West. Some parts of this land seem to be irretrievably lost and others are being slowly recovered at the cost of years of time and millions of dollars.

The first settlers in those dry States picked spots where they got the benefit of what scanty rain there was, and along the banks of streams where there was not only water but good drainage, if any of the water was used artificially. Soon there was nothing left but lands where the soil was all right but so dry and far from water that nothing could be raised except during a freakishly rainy season.

All that the land needed was rain. The thing seemed perfect-

ly simple. Rain is fresh water. If they could get fresh water onto that parched land it would surely yield crops like those of more favored spots. So they led the water down from the mountains and out over the floors of the broad, flat valleys.

The idea is as old as civilization. Archeologists find ruins of large-scale irrigation undertakings in the old empires of Babylon and Nineveh.

The fact that these areas now are arid wastes was supposed to mean solely that the ancient irrigators had degenerated or been driven off by ignorant conquerors.

Had anyone suggested then that irrigation itself might have helped to ruin the land and its once prosperous people, the answer would have been to point to Egypt. There for millions of years Nature has been irrigating on an imposing and successful scale. Every year the Nile overflows and soaks a ribbon of soil along its banks. That ribbon is all there is or ever was to Egypt. The rest is desert.

Only recently has it been realized that Nature did more than irrigate or even fertilize Egypt. Every year most of the Nile water drained back into the Nile and carried off any extra salts or poisonous "alkali" that might have accumulated.

The Nile silt, too, was valuable, and now that the Boulder Dam project has gone too far to stop, it is beginning to dawn on a few persons that perhaps the silt now trapped by the dam may have had a lot to do with the fertility of the Imperial Valley.

Or it may well be that this once-rich valley one day will be at the bottom of a vast lake. The valley gradually is sinking geologically, but Nature so far has been kind enough to save it from Atlantis' watery fate by dumping silt along the lower reaches of the Colorado River, so that the level of the soil was raised as fast as the valley's underpinning sank. What now may happen, when the Boulder and other dams are trapping and holding back this silt nobody knows.

Oh well, if anything does happen they can blow up the dams again. It is only the taxpayers' money.

On many of the irrigation schemes that have got into trouble everything worked beautifully—at first. The grateful soil returned bountiful crops. The mountain water tasted fresh, was good to drink and a plant should be able to drink water that a man can. This water had fallen in the mountains as rain or frozen rain which is almost pure distilled water. Rain not only brings no poison to soil but, in passing through and draining way, it takes with it various salts in solution, thus actually cleansing the ground.

But much water commonly called fresh actually contains small quantities of the chemicals which drain continually into the oceans from all the continents. That is why the sea is salt. The oceans are constantly giving up water in the form of vapor to be condensed as raindrops and come wandering back with more salts which have accumulated in the seas until they are unfit to drink.

Almost anyone would know better than to put salt on land. Yet that is what those irrigators were doing slowly. The imperceptibly salty water from the mountains was gradually poisoning the earth. There was not enough water for much of it to run through the soil and pass off as drainage water, which is what a part of the rainfall does in wetter climates. Instead, the water merely sank into the soil a few feet or inches and then came up again by the forces of capillarity, the same forces that make water soak into a dry sponge.

The water left behind in the soil all the chemical salts that were dissolved in it when it arrived, plus any other chemical salts that could be dissolved from the soil material itself. This is what caused the so-called "alkali," really nothing more than the presence in the soil of too large amounts of these salty or alkaline chemicals.

In the valleys of the Salt River, in Arizona, and of the lower Rio Grande, in New Mexico, are excellent examples of what may happen through improper use of man's engineering skill. The farmers mortgaged their lands to get water for the thirsty soil; they always had had some water but never were certain of the supply. With sure and abundant supplies of water in the irrigation ditches, they proceeded gradually but surely to drown out and poison their lands with alkali.

Fortunately for these farmers, their lands were mortgaged to liberal Uncle Sam. So, though they did not lose their farms, in order to use them the farmers now had to spend almost as much money in drainage works to take excess water and poisons out of their soil as they originally had spent in great dams and canals to provide what they thought would surely be the life-giving fluid.

What the Florida Canal might do in the opinion of some scientists is to replace the fresh water with salt or brackish and produce the same kind of saline desert.

In other instances, also, so-called "reclamation of land" may be a public calamity. One of the greatest catastrophes of pre-

historic time in North America has been blamed on a similar interference.

About two thousand years ago there lived in Central America and parts of what now is Mexico a great and civilized race of American Indians called Mayas. They may have been related by commerce and exchange of arts with the equally civilized predecessors of the Incas in Peru. Somehow or other this great Mayan civilization vanished. No one is sure why but one of the theories of the archeologists is that the Mayan civilization committed suicide by soil erosion.

When the Mayas first emerged into civilization, their food was chiefly Indian corn grown on the fertile bottom lands of the river valleys. Gradually they began to cultivate the hillsides also. Trees were cut down and much the same kind of "improvements" carried out that have been responsible for loss of forests in the modern United States. Just as is happening now, the soil washed down from the bared Mayan hillsides into the valleys. The streams, which ran through these valleys and served the first Mayas as highways used by canoes, gradually were choked with dirt and converted into marshes.

Both the valley fields and the hillside fields were ruined. Many experts think that this is what slowly starved the Mayas and made their remarkable civilization decay.

Just as the United States now realizes the menace of soil erosion due to cutting off Nature's protection for the soil, or due to allowing animals to eat off all this cover by over-grazing, so there may have been wise men among the Mayas who foresaw what was happening and tried to stop it but their efforts evidently were in vain. The Maya nation monkeyed with Nature once too often and too completely.

In the Mayan country, the creation of marshes in the valleys, instead of the clear streams that once ran there, was a disaster, but when Nature herself has created a marsh it may be just as dangerous to remove it as it is to create one where Nature has not intended. Several years ago Professor J. C. Jensen, distinguished physicist and weather expert of Nebraska Wesleyan University, suggested in The American Weekly a similar set of circumstances concerning the cause of recent droughts.

Throughout the Middle Western country where recent droughts have been so severe there used to be many more sluggish streams, swamps and marshes than there are now. One by one engineers "improved" these by draining them. Often the soil "recovered" turned out to be not much good, but that was not the worst of it. The absence of the marshes acted, Professor Jensen believes, to decrease the evaporation of water into the air and thus make the air in summer drier than it was in former years. This, in turn, decreased the average of summer thunderstorms and thus helped cause the lack of rain that has proved so serious.

New York State several times has been asked to stop New York City from stealing the water from under the feet of Long Island inhabitants. Long Island being long, narrow, low and completely surrounded by salt water is in some ways like Florida. The old settlers found an abundance of water by digging only a few feet down. Then the various towns on the island began pumping up water, most of which went out to sea as sewage.

The water level then commenced to fall, but slowly until New York City began to pump at its end of the island with such vigor that the level started down toward China.

It would not be so bad if this meant merely sinking deeper wells. The trouble is that when the water level gets much lower than the sea level, the normal oceanward flow is reversed. Salt water then invades the land and comes in the wells, as is feared for Florida if too much ground water is pumped out and if the canal is cut through.

When the howling Paris mob told Marie Antoinette that they hadn't any bread she is supposed to have advised them to eat cake.

Perhaps the advocates of improving on Nature will tell another, and waterless, generation of Floridians to drink beer.

Cats And Bumblebees

IN a science article published in Dec. 6 Pathfinder you quote Darwin to the effect that "the bumblebee population of England is regulated by the number of cats."

The English bumblebee is not very different from the American variety, and neither cats nor mice have any effect on the American bumblebee population. Bumblebees do not build their own nests, but appropriate the nests of field mice to their use. These are mostly nests that have been abandoned by the mice, but I have known them to drive the mice out of their nests and take possession. Anyway, mice let bumblebees severely alone, and it would be just too bad for them if they did not.—E. E. Oxley, Great Falls, Mont.—

Conservation of Soil and Human Health

BY JONATHAN FORMAN, B. A., M. D.
Editor of the Ohio State Medical Journal, Columbus, Ohio

Reprinted from Manual of Agr. and Conservation Program
(Ohio Chamber of Commerce)

DEPLETED soils will not produce healthy plants. Plants suffering from mineral deficiency will not nourish healthy animals. Deficient plants and undernourished animals will not support our people in health nor will they supply an adequate cash income.

In our virgin soil here in Ohio there are some score of minerals. It is becoming apparent that even those that are found in the minutest traces play a vital part in the nutrition of plants, animals, and human beings. Of these many minerals none is more important than phosphorus. Many diseases of animals can be traced directly to the lack of phosphorous and its associated lime in their foods, and these in turn to deficiency in the soil that produces the foods.

We all know about the part that lime plays in the growth of bone, and how it maintains normal blood clotting, normal rhythm to the beat of the heart, normal excitability to nerve and muscle and proper permeability of membranes, so that food-stuffs once in solution, can flow into and nourish all the cells of the body. When lime (calcium) is deficient, all these important functions are affected unfavorably, and we become irritable, nervous and sometimes real problems in behaviour. Not every plant that looks all right contains a proper amount of calcium. Animals will select those that do, oftentimes going a great distance out of their way to get the leaves with proper calcium content. We humans do not have this fine discrimination of taste. It is possible to vary the calcium content of a lettuce leaf as much as sixty-fold by varying the calcium content of the soil in which it is grown. With improper farm practices, lime is the first mineral to be washed away or leached through the soil.

Minerals Necessary to Life

Virgin Ohio soil had phosphorous enough for about 100 crops of grain cereals such as wheat. The importance, therefore, of calcium and phosphorous deficiency to the welfare of ourselves and our children is becoming increasingly significant. We must learn to borrow these minerals and return them again to the soil if we are to survive.

Of course we can haul from Tennessee, Florida or the Rocky Mountains mineral-bearing rocks, grind them up and put them on our soil. This is an expensive process and to repay what we have already borrowed in this way at current prices of chemicals the cost is estimated at more than $50 per acre. In so replenishing our soil we are not certain that we would be getting all of the important secondary minerals. We are just beginning to learn of the vital role that many, if not all, of these so-called secondary minerals of plant nutrition play. These elements include sulphur, magnesium, boron, iron, copper, zinc, manganese, cobalt, iodine, nickel and fluorine.

Need For Iodine

We are all familiar now with the fact that in the glaciated areas of Ohio, iodine is missing from the soil. We have found out that the use of a trace of iodine in our table salt or in the salt used for our milch cows prevents goitre and the development of those hopeless idiots called cretins. Most of us have not had the opportunity to see what iodine medication will do for children who are iodine deficient, but are still getting a partial supply; how their little bodies develop, their brains sharpen, their nervousness and irritability disappear, when they are given as much as a trace of iodine. Copper is used in parts per million to prevent anemia, both in our animals and in ourselves. We do not need much iron (about enough to make six carpet tacks), but we need that very badly and we need a consistent replenishment in our bodies. Sulphur is easily obtained from meat and eggs, so that at present we do not need to worry about a lack of this element in our diet.

Magnesium Essential

Magnesium is essential to the formation of bone and teeth and metabolism of phosphorous and plays an important part in the of the sugars and starches. If it becomes sufficiently reduced in an individual, such a person becomes irritable, the heart runs

away with itself and finally, if carried to the extreme, the victim dies in convulsions. The great extent of boron deficiency in many prodzolic soils has been discovered in the last few years. Its real function is still to be learned so far as humans are concerned. We know that it is of great importance in certain plants and fruit trees. Manganese is known to be essential for the hatching of eggs and to prevent sterility in some of the animals. In people and cattle its lack produces "Coastal Disease." Zinc has been shown to be an essential element for the development of plants. Its absence may occur naturally in plant life. It has been known to cause serious diseases in fruit and nut groves.

Vitamins and Minerals

Physicians are awaiting anxiously results of investigations which suggest that zinc has a vital role in the action of the individual's own insulin and so may be related to diabetes. Cobalt together with iron, copper and manganese, and not our ancestry, determine the quality of our blood and that of our animals. In these days when we hear so much about vitamins, it is equally important that we understand the value of minerals. Vitamins are synthesized mainly by plants. It seems no stretch of fancy, therefore, to say that vitamins have come into significance through their shortage or absence because soils which are declining in fertility handicap their production in plants. Some experimental work with tomatoes, carrots and potatoes among children demonstrates very favorable results through the use of fertilizer for improved vitamin effects. Our soils are becoming more and more deficient in minerals and less and less fertile. Thus our own health is being undermined.

Civilization Rests on Soil

The important problem before the American people is not how to procure medical care at public expense, or to spend the taxpayers' money to see that there is an ample supply of pills and potions for whosoever may apply. But we should get at the fundamental of human health which is the maintenance of soil fertility so that proteinacious materials, full of nutrients, are provided for both man and beast. Thus man, through the use of mineral-rich cereals, green and yellow vegetables unspoiled by improper storage or cooking, fruits, and milk, may have buoyant health, with a long, productive life, free from degenerative disease and infections. Our civilization truly rests upon our soil and we must see to it that it is restored to full fertility.

Vitamins And Hormones

(Note) The following item appeared in The Bulletin issued by the Calif. Dept. of Agriculture—No. 4 (1942). Note reference to the compound which is a cancer producer.

THE popular extravagant enthusiasm for Vitamin B[1] occupied attention of the Bureau during 1943. There is no evidence that its application to chlorophyll-producing plants is of general value. Negative results of many published and unpublished experiments with Vitamin B[1] application under practical conditions have failed to bear out claims and statements widely spread during the past few years. Accordingly it is apparent that any claim that it is of value in a commercial fertilizer is *mis*representation and not acceptable under the law. Claims for Vitamin B[1], in a commercial fertilizer have been discontinued as new labels were printed. Commencing January 1, 1943, any claim for Vitamin B[1], on the label of such a material sold in California will be considered cause for reporting an official sample as misbranded, or for any other appropriate action.

In striking contrast to the misleading and unwarranted exploitation of Vitamin B[1] stands the careful entry into the commercial field of hormone sprays, such as those of naphthalene acetic acid for reduction of fruit-drop. However, we have taken steps to eliminate spurious claims, without interfering with the good in connection with the use of so-called growth-regulating substances. Similar products, roughly lumped together as "hormones," although still in the experimental stage, might appear to have some value in the rooting of some cuttings, even though optimum treatment may not yet be developed. Among substances included as hormones may be compounds some of which are *cancer producers* and this suggests the great care that should be exercised in development and commercialization of any new synthetic organic substance. Even substances such as colchicin, an alkaloid extracted from the seeds or corn of colchicum, considered by plant breeders to aid in the derivation of new varieties of plants, and materials for inducing production of fruit without pollen, would fall under Chapter 7, Division V, of the Agricultural Code.

A Reader Backs The Plow

Dear Mr. Rodale:

Have read your articles in O. G. for some time in regard to plowing and being one who has followed the plow for many a mile I cannot say I agree with these 'No plow' enthusiasts.

While there are many different types of plows, in the main two types stand out, the breaker and the stubble plow. The breaker with its long mouldboard as you know is made to flop the furrow upside down and whoever has seen a 4 to 6 horse breaker turn a 24 inch furrow, cutting off oak roots and grubs up to 3 inches and laying out rocks on the surface weighing over 50 lbs. will have to admit that it is a valuable instrument and has a place in the scheme of subduing the primeval.

No disc harrow can do the work these breakers have done and as neatly. There are disc plows that do admirable work and I have used them but, without a heavy double action disc harrow to follow them and level the ground, they would leave the ground in an awful mess. Coming back to the breaking plow with its knife coulter and share adapted to cutting all roots both horizontal and perpendicular we have an instrument with but one purpose; to subdue the wild land and get it under control and I think for that purpose it can't be beaten.

When it comes to plowing land that is under control it is another story.

The type of plow that will tilt the furrow at an angle of say 45 degrees is the best for all general purposes. Some farmers however, who let their farms go to weeds or grass, in order to get this stuff out of sight, use a plow that nearly approaches the breaker type. This as a rule is bad farming and unnecessary as a jointer can be used, which is a small auxillary plow that turns a small furrow away from the furrow cut and enables the ordinary plow to bury all trash without putting it at the bottom of the furrow as the breaker does. With good plowing the idea should be to plow no deeper than the good top soil extends and to mix whatever is turned under from top to bottom.

In reality the only difference between discing and plowing is the size of the furrow. Each instrument turns a furrow but one turns it so much deeper and in the case of the breaker type it flops it neatly upside down. The right idea to my mind is to get away from this breaker type of plowing on old land and use the right type of plow and plow the right depth.

There are times as every good farmer knows when discing can do a better job than plowing.

When putting in fall grain for instance on a well-tilled corn or potato field that has not been harvested the disc makes a fine shallow seed bed that is better than a deep plowed one for small grains but try to disc a piece of clover sod in the spring, to plant corn or potatoes on and you will run into trouble. They require a deeper seed bed.

The fault is not with the plow but not knowing how and what plow to use. I remember reading years ago in Practical Farming of a man named Mr. Perry who brought a worn out Ohio farm up to the highest degree of fertility by a three year rotation of clover, potatoes and grain. He stressed proper plowing and used mostly a 40X Oliver Chilled Steel Plow as his favorite plow. He never cut a second crop of clover for hay but clipped it and let it fall back to form a mulch to plow under. People came from all over the state to learn his secret. This man used a plow but he used it right.

I remember one time when I lived in Wisconsin, I limed 5 acres and planted it to sweet clover to plow under for green manure. It came up so thick and rank a dog could hardly follow one thru it.

When I plowed it under in the late fall I had to put on the heaviest log chain I had to turn it under and the horse on the land side could hardly keep out of the furrow. It was about 6 ft. high. Did I raise a bumper crop next year? I'll say I didn't. The spring was dry and that stuff just lay there and I lost the use of the land that summer but next year I got it all back.

Here was a case where a plow had to be used but I should have plowed it before it got too woody; say a month or two earlier. I would like to see one of our 'No plow' exponents tackle a piece of land like that with a disc.

Organic Gardening caters

mostly to those who garden instead of farm and to those who have a small garden of around an acre or less. I would say a lot more pleasure with a lot less work could be had if there was always some crop left on the soil right up to frost. Most of these gardeners, when the beans, corn or tomatoes are thru, let the land go till next planting but I never let up with my planting and as soon as a crop is about thru I pull up what is left for the compost heap and go over the land with a one wheel cultivator using the sweep and cutting off all weeds well under the ground. Then after it has lain a day or two I put on the small plow and plow in some annual to take the place of the weeds. Up North it would be turnips, buckwheat or rape—anything that will grow up and die down when winter comes. Then, when you want to turn your land over in the spring or just before freeze-up you can do it with your hand plow and you will enjoy it instead of cussing the weeds that ordinarily take possession.

Weeds never take possession of my garden for long and they are unnecessary in any garden that is handled right.

The trouble with most people is that they lose interest when the hot weather comes and don't think ahead of what the weeds will do to their garden. You've got to have your heart in gardening and use your head too if you're going to make a success of it. Now that I have made my home in Florida where we can 'grow' compost heaps the year round I find that the lowly earthworm is increasing since I stopped using commercial fertilizers.

Yours very truly,
M. G. Carpenter,
Panama City, Florida.
Feb. 1, 1944.

Insect Friends . . . . . By J. CASEY

FROM OUR DUMB ANIMALS MAGAZINE

Harmless dragonfly

THE strongest fliers of all insects are the DRAGONFLIES, of which there are more than 300 species native to the United States. The most common, perhaps, are those variously known as Mosquito-Hawks, Devil's Darning Needles, Snake Doctor and Snake-Feeders. The most appropriate name is that of Mosquito-Hawk, because of the unusually large numbers of mosquitoes devoured by these fast-flying insects.

The dragonfly is falsely accused of inflicting painful stings, being in league with the witches in feeding and doctoring sick snakes and, lastly, being able to sew up the eyes, ears and mouths of bad children!

In reality, the dragonfly is a most formidable foe to mosquitoes, therefore, a valuable friend to mankind and should be protected, instead of molested. Its food is composed of countless numbers of mosquitoes, gnats, flies and other small injurious insects. It is perfectly harmless and does not bite or sting.

The mouth parts of the dragonflies are strong biting jaws. They have very large rounded eyes, composed of several thousand elements united—this gives the head an "over-size" appearance. The head and long slender body are bright green, the legs black, the wings a metallic luster, spreading horizontally when at rest—truly a beautiful, useful and interesting insect.

Dragonflies are usually seen near water, but once in a while one may light on the window screens where bountiful meals are theirs for the taking.

In watching the antics of the dragonfly, one is reminded of the maneuvers of a skilled aviator.

Reader's Correspondence

Please write on one side only. Do not make your letters too long. Put each different query on a separate sheet. Send stamped, self-addressed envelope for reply.

POTASH (Vegetable)

Can you advise the best way to get potash. We use wood ashes but don't have enough of them and would like to use other natural forms of potash besides compost of which we never seem to have enough mostly because of labor shortage.

Jim Allen,
West Plains, Mo.

Answer

In addition to wood ashes, corn cob ashes are about ½ potash. Plant matter in general is rich in potash; for example, the ash of banana skins is about 42% potash; grapefruit skins 30% stringbean strings and stems 18% canteloupe rinds 12%.

MANURE (Chicken)

What do you think of chicken manure being placed in the garden?

Samuel Berman,
Brooklyn, N. Y.

Answer

Chicken manure is a marvelous thing for the garden, but it should be composted first. If you have some old chicken manure that has been rotting for six months or more, it can be used. Fresh droppings are dangerous to use in the garden because they may burn the plants. In this respect chicken manure is entirely different than other manures.

FISH AS A FERTILIZER

What do you think about putting old fish in the garden to rot?

Samuel Berman,
Brooklyn, N. Y.

Answer

It would not be a good idea to put old fish in the garden to rot, unless you put it in a place where you are not going to plant for at least a year. Otherwise it is best to make compost out of it, and it would not be advisable to do this in the city because old fish would smell very badly. Composts made with manure and the ordinary compostable materials do not smell, but such things as fish and chicken cuttings do give off a powerful odor.

SEED DISINFECTION

I would appreciate your views on seed disinfection.

Oliver Lawrence,
Jackson Heights, L. I.

Answer

Chemical disinfection of seeds is not advisable by anyone who is interested in the nutritional quality of the crop. Some of these poisonous chemicals, it is believed are absorbed into the growing plant.

HORSES (Food)

Mr. Roger Selby,
Portsmouth, Ohio.

Knowing that you are the largest breeder of Arabian horses in the United States I would like to ask your opinion.

As you know, we here are interested in growing food products, for man and animals, without the use of chemical fertilizers. I have noticed that horses sometimes chew out a section of the front wooden part of their stalls and am wondering if this is not a symptom of hunger. It is a known fact that pigs will chew to pieces their wooden troughs when there is a lack of some element in their food, such as phosphorus. Perhaps you might have some information regarding horses.

In France, I have read that a certain farmer raised hay by the organic method and received a large premium for it, from breeders of horses, who recognized its value.

Answer

With respect to horses chewing on the wood of their mangers, or "cribbing", as I believe it is called, our experience has been that this is due to a lack of sufficient minerals in their diet, which, in turn, is apparently caused by continuous cropping of the land without returning the minerals which have been withdrawn.

With our horses, we attack this problem in two ways,—first, the quick remedy of keeping mineral blocks constantly available in their manger boxes, and secondly, the slower method of striving to constantly build up the mineral content of the soil,

so that feeds grown upon it will in turn have the proper mineral content. We feel that we have been quite successful in this, and the greatly improved appearance of the animals is evidence.

Best wishes,
Roger A. Selby.

SOIL—Sterilization

Dear Mr. Rodale:

Being a person who is inclined to do things in the proper way as far as I know it, in past seasons before planting my seeds in boxes in the house I have always brought the soil into the house and sterilized it by putting it in a pan with a small amount of water, and setting the pan on the stove where it bubbled and steamed for half an hour or so. I then cooled it and planted my seeds. True, I never lost any seedlings by damping-off but for some reason, I didn't know then, my little plants never grew sturdy and strong the way I wanted them. I even wrote to a seedsman and asked him what was the matter, but his answer was not very satisfactory. I never used commercial fertilizers because I had always read that small seedlings did not need much nourishment. Since I have been reading "Organic Gardening", for over a year now, I have found the answer, in fact several answers, to my failure. In the first place, the boiling I gave my soil took all the life out of it, and my seedlings were starving. Also I never had any compost to mix in the starting soil for my seeds. This year things are going to be very different when I start planting my seeds.

I read each copy of "Organic Gardening" more than once and feel that everything between the covers is true.

Yours sincerely,
F. O. Lewis,
Dayton, Ohio.

Answer

Dear Mr. Lewis:

Yours is the second letter that has come in from readers who have had failure with plants that they have grown in sterilized soil.

CHICKENS

Dear Mr. Rodale:

Would you be so good as to give me your opinion, from the point of view of nutrition—of getting maximum of nutrition at lowest cost—, on a question we have to decide about our chickens. Last year we let them have the run of the farm, which was all very well and they were remarkably fine fowl and we were proud of our beginner's luck, until they found their way to the house and flower garden. Then there was havoc. This summer we must either pen the chickens or pen the flower garden. Penning the chickens is, of course, what other people do. But I am sufficiently a questioner of tradition to wonder whether in our case penning the garden —which could quite easily be done—wouldn't give us enough more essential food value from our eggs and chickens to make it worth while.

Miss Frances H. Flaherty,
Brattleboro, Vt.

Answer

Dear Madam:

We agree with you that penning up your garden would be much healthier for your chickens, and indirectly for your complete household—the ones who eat these fowl. This reminds me of a conversation I once had with the president of a large publishing company whose chickens were consistent winners of blue ribbons at the shows. I thought that he must have had a very rigid program of feeding and training for these chickens, but he stated that his secret was in the fact that his place was near the woods and he let his birds roam through these natural surroundings. In this way they seemed to obtain those rare things found in woodsy soil, which perhaps were not present in the regular daily food rations he gave them.

WOOD ASHES

Dear Sir:

I am constantly on the lookout for new waste products to use in the making of compost. One, like grandmother's glasses, was under my nose all the time. Wood ashes. Memphis is a hardwood center and the boilers are kept hot by the wood waste and sawdust. How much should be used on the land?

My wife and I have a fifty-two acre farm and despite war restrictions we plan to put as much under compost as we can. My wife tells me that "Organic Gardening Magazine" is my Bible. It is. The Bible of a new soil with which to build men and women who will build anew this nation of ours.

Joe M. Currie,
Memphis, Tenn.

Answer

Dear Mr. Currie:

It would be much better to use wood ashes in the compost heap in place of lime. You could

not use too much wood ashes alone on the land because it would not be a complete food and would give you too much potash.

Wood ashes would make an ideal fertilizer when used with some dried blood for nitrogen, and bone meal for phosphorus. Further details on this subject are contained in the April issue of ORGANIC GARDENING.

PINE NEEDLES

Gentlemen:

We have several Pine trees in our yard and it seems wise every spring to sweep up all of the short Pine needles that have fallen onto the ground in getting the yard ready for next year's grass. Now then, can I use these Pine needles in the compost? I have found that when they have been spaded into the ground, they do not seem to decay as other material does, so if I could use them, it would be considerably helpful in the way of bulk that would be fine to use with the compost, provided that it is alright.

Earl C. Booth.
Columbus, Indiana.

Answer

Dear Mr. Booth:

Pine needles are quite stubborn, and it is best to keep them in a separate heap to weather first before placing them in the regular compost heap. They should be wetted down as much as possible, and stirred from time to time. You will have to use your own judgment as to when you feel they are sufficiently withered to be used in the compost heap.

ORCHARDS

Dear Sir:

We operated a commercial orchard, the greater part of which has been in Apples but was gradually converted to what we call soft fruit orchard, namely cherries, apricots, peaches and plums. While in apples, *the ground was saturated with lead arsenic,* making it difficult to overcome the toxic condition. After growing rye for several years, and manuring very heavily, we slowly got the land in shape to grow legume cover crops.

Some of my orchard is still in pears, which necessitates spraying for codling moth. For the past four years I have used Cryolite, which contains Fluorine, We thought this type of spray might be less harmful to soil bacteria than arsenic of lead. (Cryolite seems to me a better spray than arsenic, for it will decompose and not remain in the soil as does arsenic.) In your article on sunflower seeds in the April 1944 issue, you speak of the high toxicity of Fluorine. I am enclosing a wrapper of the Cryolite I am using, giving the ingredients. Will you kindly give me your opinion as to which you believe the more injurious to bacteria life, which, I understand, is needed to break down the cover crop we grow in the orchard.

For four years we have had rye as a cover crop in our pears. When grain was ripe, would go through with a planker to shatter the grain. Pears are picked about the middle of August. The pickers at that time, tramp in the seed and in a few weeks we have

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Dept. O. — Santa Cruz, Calif.

a heavy stand of rye, which causes a heavy mulch. The experiment station recommends a heavy dose of chemical nitrogen to break down this straw. Our experiment station man told me it was his opinion that as much as twenty pounds of Sulfate of Ammonia would do no harm if we had plenty of organic matter.

This spring I no longer dared to let the rye remain, for I thought my terminal growth did not quite warrant it. I am afraid of chemicals, so instead of using five pounds per tree as recommended, I have used not more than half as much. From a long range point of view, do you think I ought to have left the rye undisturbed by discing, to increase the mulch, which in turn, as I understand it, builds up nitrogen?

It is not practical for me to compost. We specialize in fruit and keep no livestock. Sometimes we can buy barnyard manure, but not enough. In that part of our orchard, other than the pear block, where vetch and Austrian Winter Peas will grow, and by their consistant use as cover crops, I hope manure will not be necessary.

The orchard that has been out of orchard the longest, has the most angleworms. The other tracts vary from very few to none in the pears. Would you deem it advisable to try to introduce angleworms in view of the arsenic in the soil?

M. L. Matson,
Zillah, Wash.

Answer

Dear Mr. Matson:

I believe that Cryolite and arsenic of lead are both bad and will always cause trouble. I have been told that in your territory, due to the use of these sprays, the land has become so toxic that even a cover crop will not grow in the orchard.

The latest work in orchards seems to show that excellent results are produced by mulching around the trees, and we know from the experiences of Sir Albert Howard, and from what we have already seen in our own little way, that the ideal method of handling an orchard is to first put a treatment of finished compost around the tree, starting one foot away from the trunk and going to about two feet beyond the drip line and then to cover with a mulch. If you keep on doing this the tree will get strong enough to withstand insect infestation. Perhaps you may have a little bug or so here and there, but I am sure that it is impractical to try to turn out a perfect looking fruit with absolutely no flaws. That is not how nature does it, and if you try to do it, it will be done at the expense of your fruit and at the eventual destruction of your orchard.

It is hard to advise what to do about the angleworms and the question of the amount of arsenic in the soil. Possibly you might make small tests.

Another important thing is that you cannot farm safely without livestock, regardless of whether you operate in orchards or other crops. Without livestock it is an unbalanced agriculture and you will always have trouble.

SANDY SOIL

I wonder if the idea (organic) is good in clay or loam, but no good or impractical in our South Florida sand?

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ORGANIC GARDENING,
Emmaus, Pa.

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ORGANIC GARDENING,
Emmaus, Penna.

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ORGANIC GARDENING
Emmaus, Pa.
Gentlemen:
Enclosed is $2.00 for one year subscription (12 issues) to Organic Gardening.
NAME .....
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Answer

Replying to your request about whether the organic idea is good in your South Florida sand, the answer is "absolutely yes". In fact, the more sandy your land is, the more important is it that plenty of compost be put into it.

ANIMAL CARCASSES

Gentlemen:

I have a lot of wild rabbits around my place. Would it be feasible to trap these rabbits and throw them into the compost mixture whole with the skin on? I should think that I would have to skin them and remove the insides and then cut up the carcass before it could be mixed up with the balance of the material I was composting. If I can use fresh rabbit meat and the insides in the compost, would the smell of raw meat and blood attract wild animals, like skunk, wood-chuck, fox, hawk, etc.

The point I am anxious to know about is will proper sprinkling of the raw meat with wood ashes or ground lime stone and then carefully mixing it with the balance of the composting material keep the odor from getting out of the pile and attracting wild animals? Your advice on this point will be particularly appreciated.

R. A. P.
Hartford, Conn.

Answer

Would suggest that you handle the rabbits separately, and not in your regular compost heap, because under ordinary conditions they give off quite an odor in the heap. It is best to throw the whole animal into the heap without taking the skin off. I believe that the best way to handle small animal carcasses like the rabbit, is to make a pit in the ground. Make your compost heap in the ground, and then cover it with about one foot of earth. I think it would be best to allow about two years to decay under such conditions.

If you just put a small quantity of such animal bodies in your regular compost heap, there probably would not be much odor. The odor will come in just one stage of decomposition which takes about three weeks.

Manure does not give off an odor in the compost heap because it is a fibrous material which decays easily. In handling your rabbit bodies as you suggest, be sure to use plenty of lime. Hydrated lime would be better than ground limestone. This will discourage animals.

I have never handled wood ashes with animal carcasses, so I cannot advise you on that point, but you can experiment and advise us of your results. Where you put some of these animal bodies in your regular compost heap, you would want to put an extra quantity of earth around the top and sides.

THE KIND OF GREEN MATTER

Organic Gardening

Dear Mr. Rodale:

I do enjoy my Organic magazine so much, and have obtained so much valuable information through it that I'm beginning to feel a bit "cocky" on the subject of raising or growing *good* food, food fit for human consumption.

Have been using cabbage and cauliflower trimmings almost exclusively as the green part of my compost heaps this winter. Would these strong vegetables, so rich in sulphur, etc, lessen the quality of the finished humus, or are they equal in value to the weeds, dried grass, etc., which I find hard to obtain in winter?

This material does not seem to wilt as readily as other less fibrous vegetation, will it take longer to deteriorate in the heap? I have also had some trouble in not being able to get the high temperature required for proper fermentation, *no doubt this has been due to an excess of moisture and too much soil which* I had been spreading on pretty generously. Having had quite a bit of training along nutritional lines, and having followed pretty strictly a well balanced and carefully combined diet over a period of

(Continued on inside back cover)

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While these books are not written from our "organic point of view" they should be in every gardener's library.

Organic Gardening — Emmaus, Pennsylvania

(Continued from page 31)

many years, I had begun to wonder just why I could not quite reach the standard of optimum health.

My first copy of Organic Gardening was like a revelation to me. There was the answer, as plain as day. Sick soil, producing sick vegetation, to feed a sick world, a sick humanity. I'm hoping for great things from my garden and orchard this year. Thank you again for past favors.

Mrs. H. J. Schauer,
Roseville, Calif.

Answer

Dear Mrs. Schauer:

You state that you are using cabbage and cauliflower trimmings almost exclusively as the green part of your compost. This is not sufficient. I would strongly urge you to add leaves, and a wide variety of green material such as grass clippings, etc. Leaves are the best green material for compost because they come from trees, the roots of which go down as far as 20 feet into the earth and bring up plant food which does not exist sometimes in the surface soil.

The material you are using may take a little longer to decay, but they will decompose under the action of the compost heap.

The two reasons that you mention for not being able to get the high temperature, namely, too much moisture and soil sounds reasonable. You must be careful to follow all of the instructions for making the heap carefully.

COMPOST—Dishwater

Will dishwater containing soaps be injurious to composting piles?

Answer

Replying to your letter of March 17th, we would not recommend dishwater for the compost piles because it contains strong soaps. Not only is this bad for the compost heap from an organic point of view, but the nature of soapy water would interfere with the aeration of the compost heap.

LEAVES

I am collecting oak leaves (there are plenty here as we live in the woods). Shall I mix these leaves with the organic pile when I start building? Or make it a separate pile.

Answer

In using leaves in the compost heap, they should be placed in thin layers. We would not use leaves exclusively in the compost heap if possible. In placing green matter in the compost heap use about 5 or 6 inches of weeds and other material, and then a very thin layer of leaves before you start putting on the manure. If the leaves are put on too thick they will tend to cake and will not decay as readily.

BONE MEAL

There are a few questions on my mind about "Bone Meal."

Do they use chemicals in preparing Bone Meal?

Would you consider it natural or chemical fertilizer?

Should you compost Bone Meal?

Ralph J. Till,
Chicago 21, Ill.

Answer

Dear Mr. Till:

As a rule we do not believe any chemicals are used in preparing bone meal. There is raw bone meal and steamed bone meal on the market. They would be natural fertilizers; that is, organic.

Bone meal is considered slow acting, but the steamed bone meal acts faster than the raw, and it is best if you could compost this material. When you purchase bone meal specify that no chemicals are expected to have been used in its treatment.

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ORGANIC GARDENING
Emmaus, Penna.

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By Sir Albert Howard, C. I. E., M. A.
Formerly Director Institute of Plant Industry Indore, and Agricultural Adviser to Central India and Rajputana

Sir Albert Howard C. I. E., M. A.

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Emmaus, Pa.